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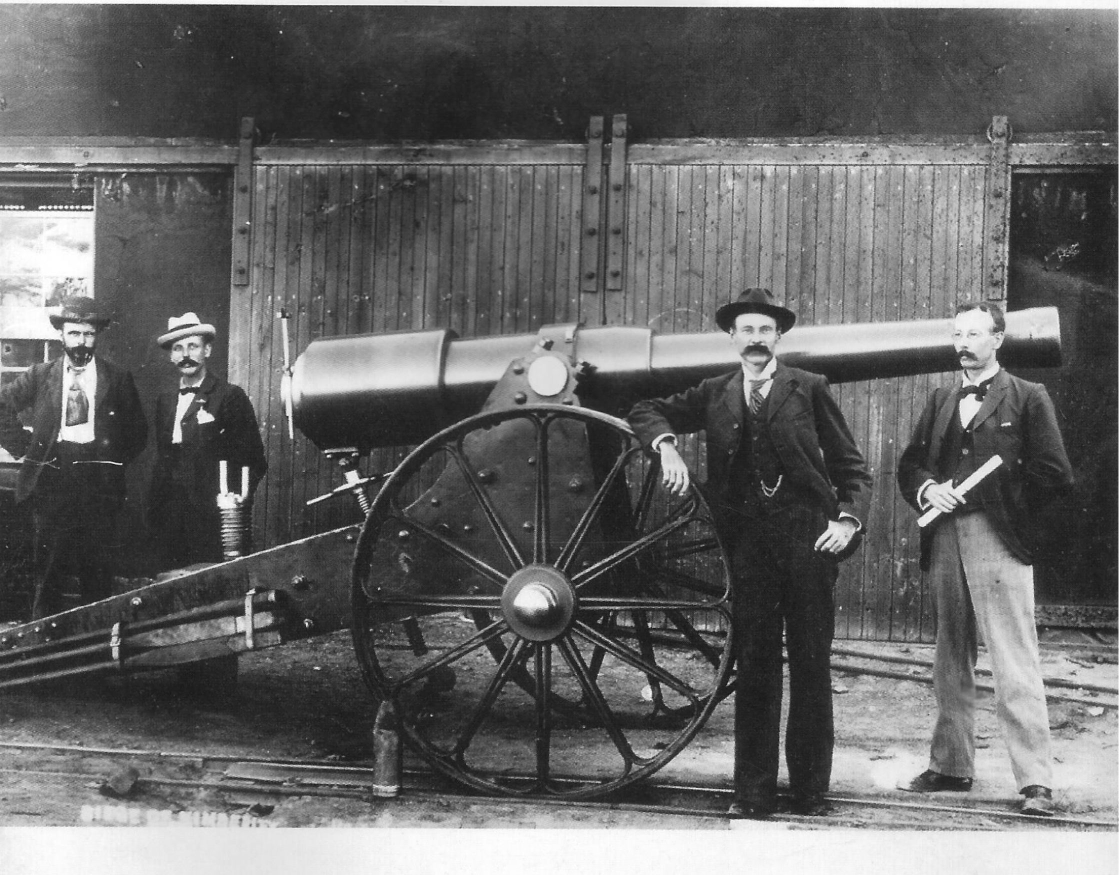

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EXCERPT MINUTES OF PROCEEDINGS
OF THE MEETING

OF THE

INSTITUTION OF MECHANICAL ENGINEERS,

IN LONDON, 28TH JUNE 1900

SIR WILLIAM H. WHITE. K.C.B. LL.D. D.Sc. F.R.S
PRESIDENT

BY AUTHORITY OF THE COUNCIL

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NOTES ON THE CONSTRUCTION OF "LONG CECIL", A 4.1 INCH RIFLED BREECHLOADING GUN, IN KIMBERLEY, DURING THE SIEGE 1899-1900

BY MR. EDWARD GOFFE, *Associate Member* of KIMBERLEY.

The object in view was to make a gun of greater power than those possessed by the garrison, which were 2.5-inch R.M.L. guns (7 pounders), and were not big enough to effectually reply to the enemy's 15 pounders, or to make any impression on his works.

A gun of about 4 inches bore, firing a shell 25 lbs to 30 lbs weight, appeared to meet the case, and to be possible of construction.

The possession of a billet of hammered mild steel (originally intended for shafting and ordered as such), 10 ½ inches diameter and 10 feet long, made by Messrs. Sybry, Searls and Co., of the Cannon Steel Works, Sheffield, and of several bars of 6-inch by 2 ½ -inch Low Moor iron, in the workshops of the De Beers Consolidated Mines, really suggested to the late Mr. George Labram, chief engineer to the Company, the possibility of making the gun, by boring the steel bar to form the tube, to be strengthened by rings shrunk on, made of the Low Moor iron. The makers of the billet subsequently wrote that the steel, from which the inner tube was constructed, was originally intended for shafting, and was considerably lower in carbon than they would supply for the purpose of making gun barrels. Tensile tests from this steel would have resulted somewhat as follows: – 27 to 30 tons per square inch breaking strain, with 20 to 35 per cent. elongation in a length of 8 inches, with 40 percent reduction of area.

The resulting gun would evidently be of a type similar to an early "Armstrong", heavy for the work done compared with one of a more modern type, but in this case weight was a minor point to be considered, ease and quickness of manufacture being perhaps the leading ideas.

The first difficulty met with was the resistance of the military authorities to the attempt to make the gun, but as this was hardly a mechanical difficulty, further reference to it may be out of place. However, on Christmas Day 1899, Mr. Rhodes, Chairman of the Company, gave the order to Mr. Labram to make the attempt. Work was immediately started, and then the difficulty consequent on ignorance, on the part of both Mr. Labram and the author, of practical gun design, was first met with. This was overcome by a search in all books available, and the scattered information so obtained brought together. The sources of information were: - The articles on Gunnery,

&c., in the Encyclopaedia Britannica; the Military Treatise on Ammunition (which had been previously used in gaining information to make shells and cartridges for the 2.5-inch guns earlier in the siege); Articles on Modern Guns in "Engineering," &c.; and from the military "Text Book on Gunnery," brought forward by an enthusiastic volunteer officer, and which proved very serviceable. During the progress of the work in the shops, assistance was also given in many details of gun-shop practice, the form of special tools used, &c., by several of the employees there, whose previous experience in Woolwich Arsenal, the Elswick works, and elsewhere, was willingly given to forward the work in hand.

Approximate calculations only were made, for two reasons, one that it was not considered necessary to go into very fine calculations when the two principal factors, the powder pressure and the test strengths of the materials to be used, were not known, and could only be estimated, recourse being preferably made to comparison of the performances of similar guns. The other reason was that time was pressing – the designing, and supplying of sketches going on simultaneously with the making of the gun in the workshops.

The stock of powder in the town was of many kinds, ranging from "mealed" to compressed cylinders 1 ½ -inch diameter by 2 inches long. Most of it had been kept for a long time, much of it over ten years for certain, but it did not appear to have deteriorated, still retaining a good glossy surface.

The cylinder powder (black) was evidently the most suitable for use, but there was not very much of it, so preparations were made to compress the finer powder into blocks, and so form a slower burning powder. The possibility of the compressing not being successful when the stock of cylinders was exhausted, and of having to use all kinds, had to be faced, but there proved to be sufficient cylinders to provide cartridges as long as the gun was fired.

From data available it appeared that 50,000 lbs. to the square inch would be a suitable maximum pressure to allow for, that being about the maximum pressure calculated, when using a charge of 5 lbs. of powder in the space which would be available for a powder chamber. But while using the slow-burning powder the shell presumably would begin to travel before that pressure was attained. Many charges of 6 lbs. were used while the gun was in action, the maximum pressure due to these conditions appearing to be about 90,000 lbs per square inch, but for the same reason, probably the actual pressure reached would not much exceed that obtained from the use of the smaller charge.

A powder chamber of 4.25 inches bore it was found would just contain seven cylinders of powder, four of 1 $^{3}/_{8}$ inch diameter, and three of 1 $^{1}/_{8}$ inch diameter, their combined weight for 2 inches of length being just 1 lb. With this diameter of chamber, to obtain

a normal air-spacing, the length required to be about 12 inches. Next the breech screw must necessarily be about 5 ½ inches diameter, and allowing a length of thread equal to 1 ¼ diameters and about 2 inches of obturator, the length of the breech block would be, say, 10 ½ inches. The total length of the steel billet was 10 feet ¾ inch, so deducting from this 1 foot 10 ½ inches, the length available for the bore was 8 feet 2 ¼ inches, very nearly 24 calibres in length.

Upon this basis the strength was next figured out, and the tube alone first taken. Using a formula for the strength of a thick tube subjected to 50,000 lbs. per square inch internal pressure, the greatest stress in the material was found to be 70,000 lbs. per square inch. This showed, as was expected, that the tube could not be used without shrunk rings.

By shrinking on two rows of rings, each 2 inches thick, a reduction of the greatest stress in the tube to about 40,000 lbs. per square inch, and that in the rings to 20,000 lbs. per square inch, was calculated, and this it was considered safe to allow. That there was sufficient strength was evident; but the author would like to know really what pressure was attained at any time, the only sign of strain being that the powder chamber has enlarged slightly and is now barrel shaped, the diameter at the centre being fully $^{1}/_{32}$ inch greater than as originally made. This is apparently due to direct compression of the metal, as the outside diameter was carefully gauged when an opportunity was given by some of the rings being removed, and was found to be exactly as made.

The order to make the gun was given on the evening of Christmas Day, 1899, and at the start of work next morning the billet of steel was taken into the machine shop. A lathe of 12 inches centre with bed 14 feet long was used, the extra length of bed required for working the boring bars and rifling gear being obtained by the use of the bed of a similar lathe set in line with it, with the headstock removed. This was already in position, being used when working on lengths of shafting, &c.

Most of the men required on the work had to be temporarily withdrawn from the redoubts where they were stationed, forming part of the Town Guard. During the building of the gun and making of ammunition, the workshops were always under fire from the enemy, many shells, including 94-pounders, bursting around and passing over the buildings, none however actually doing damage; but it was very trying for a man to stay at work at a lathe or other machine, hearing shells bursting around, and not knowing whether the next would come inside or not, and all those who had that experience deserve appreciative mention for the way in which they stuck to their posts.

Fig. 2, Plate 40, shows the general construction of the gun. The steel billet was first turned all over outside, a shoulder of $^{1}/_{8}$ inch being made to take the thrust of the trunnion ring, the largest diameter being 10.5 inches. It was turned tapering towards

the muzzle, a parallel part about 9 inches long being left there to be used as a journal when boring. For boring, the breech end was held in a dog chuck with the muzzle revolving in a hard wood bearing, and first a twist drill 1 ½ inch diameter put right through. This was followed by a twist drill 3 inches diameter, then the end counterbored with a tool and a boring bit, Fig. 7, Plate 41, started, enlarging the hole in one cut to 3 $^{15}/_{16}$ inches diameter. The bit was plentifully supplied with water through the bar, which was one belonging to a diamond boring drill. All went through without any special difficulty, but experience showed that the boring cut was too heavy, and it would have been better to have taken two cuts for that amount.

While this turning and rough boring were being done, which occupied about a week, the rings were being forged, nine being wanted for the first row, 10 ¼ inches diameter inside (less shrinkage), and four wanted for the outside row, about 14 $^{1}/_{4}$ inches diameter. These were all made from the 6-inch by 2 ½-inch Low Moor iron, a length of bar being cut, bent to a circle, and the ends welded together. As these were finished they were passed on to the machine shop, where they were turned, faced, and bored to gauge.

The trunnion ring was a greater undertaking than the plain rings, and the difficulty of making a satisfactory weld in so heavy a piece of work, with the appliances at his command, was overcome by the leading blacksmith, by working it out of a length of 6-inch by 6-inch Low Moor iron, starting a small hole through the centre, and enlarging by successive heats until he had it to the required size for machining.

By the time the rings of the first row with the trunnion ring were made, the tube was ready to receive them. For shrinking, the tube was held vertically under a convenient derrick in the yard, first with breech end upwards. The ends of the bore were plugged, and a circulation of cold water arranged inside to keep the tube cool. The rings were heated on a plate over a wood fire, the bore being gauged until sufficient expansion was evident, then lifted by the derrick over the end of the tube and dropped into place, the trunnion ring being the first to go on, resting against the shoulder. As a precaution against possible travel endways while cooling, each ring was clamped by longitudinal bolts, and the adjoining one on which it rested kept cooled down by a stream of water from a hose pipe. The tube was reversed to put on those rings in front of the trunnions, and, the whole of the first row being in place, it was returned to the lathe, and the outside of the rings turned up to form a seating for the second row over the powder chamber. The process of shrinking these was the same as for the first row, and when they were on, the barrel was again returned to the lathe for finishing.

The final boring was then begun, the tool used being a studded bit with double-ended cutter, Fig. 8, Plate 41.

Meantime, the question of rifling had been gone into, and, the increasing twist

appearing more desirable and easier on the gun than the uniform twist, it was decided to make it so. To effect this the rifling attachment, as shown in Fig. 6, Plate 41, was devised, the idea being given to the author by remembering one of Sir W. Anderson's lecture diagrams. The author has since learnt this method is still used in gun factories. The drawing shows a channel-iron bolted to two cross channels, which are bolted to the ends of the lathe bed. On this channel-iron the developed curve of the spiral – a semi-cubical parabola – was set out by its ordinates. A planed bar to act as a forme was bent to the curve and screwed down with countersunk screws. The hardwood blocks, forming the guides to the rack, and bearings for the rifling bar, were bolted solidly together and to the saddle of the lathe. The end of the rack (which was a stock one as used on the washing machines) is furnished with one little roller, travelling on the "forme" bar, contact being kept by a cord attached to the underside of the rack, carried over a pulley at some distance and having a weight at the end. A small guide pulley should be shown on the saddle to allow for vibration of cord with travel of saddle. The traversing of the saddle was done by the leading screw of the lathe, a small belt pulley being put on in the place of the usual "change" wheel, with a belt from the overhead drive.

A detail of the rifling head $^1/_{10}$ full size, is shown, Fig. 9, Plate 41. It was formed of a solid block of steel, turned to fit the bore of gun, into which the end of the rifling bar was tightly screwed. The tool was able to revolve slightly on its pin as a centre, being kept up to position by the set screw and packing block, which also regulated the depth of the cut taken, while clearance on the return stroke was possible by the giving of the spring. A felt pad held by a washer was attached to the head in front of the tool, while the head drew another wad of felt behind it, to clean the bore of cuttings as made, and a supply of soapy water under pressure was forced in behind the head, the two semicircular grooves being provided to allow the supply to get to the cutting edge. The only serious trouble experienced in the workshop processes was at this point, when it was found most difficult to get the tool to cut properly, and a lot of time was spent in trying to find the reason, three grooves only being got through between about ten o'clock one morning and late the following night. The material could not be at fault, as it had been found perfectly good, without flaws, and very clean cutting up till then, and new tools and different lubricants were tried, but with no success, until the packing block, which took the pressure of the tool, and which consisted of a small piece of iron, was noticed to be denting, when a new one of cast steel hardened was put in its place, and no further trouble was experienced, the remaining twenty-nine grooves being finished in about eight hours from then.

The rifling was started from the extreme end of the barrel at the breech, so that there was about 2 feet of length to spare, to be afterwards bored out for breech and powder chamber, so that should a false start have been made with a groove by accident, no damage would have resulted. After rifling, the bore was lapped out to take off any

roughness left by the tool, and then reversed in the lathe and the powder chamber bored out, a double-ended tool similar to that shown by Fig. 8, Plate 41, being used.

The breech-block screw having meanwhile been made, the inside was cut, and the block fitted in. In cutting this thread in the barrel, the question of the ending of the cut inside had to be met, and the simplest way seemed to be to let the tool finish in a clearance hole, and to drill this hole inside: the little drilling machine, Fig. 10, Plate 41, was made, being worked by a gut band from a convenient source of power.

The breech-block and obturator are shown in detail in Figs. 3, 4 and 5, Plate 40. The De Bangé system of obturation was adopted, that appearing to be the most efficient and easily made. The obturator pad was made of rings of sheet asbestos soaked in melted tallow, and proved quite successful. The breech-block as made first and used with radial firing is shown in Fig. 3. The block was of hammered mild steel, the same material as the tube of the gun, screwed with a V thread of ¾ inch pitch with flattened top and bottom. The handle-bars and plate are one forging, fastened to the screw with six tap bolts. The obturator bolt with mushroom head was made of mild steel, 1 ½ inch diameter shouldered near the middle to 1 ¼ inch diameter, and held by lock nuts in a recess at the back. As thus made about 100 rounds were fired with this obturator. Figs. 4 and 5 show it as subsequently made, the reasons for which alterations will be described in due course.

It was arranged originally to have an interrupted screw, cut away in three sections, so that one-sixth of a turn of the handle-bar would release the breech-block; but consideration of the time to be saved by not cutting it, which it was thought would be at least two days, and the further consideration of strength, induced the author to urge keeping the screw intact, the actual extra time taken in unscrewing the whole way being only a few seconds.

With the interrupted screw, a safety-vent closing device was necessary, and one was made. One handle, as turned to unscrew the block, moved a plate sliding on the end of the barrel, which by means of a pin working in a diagonal slot closed the vent with a light plate, the reverse action taking place when the handle was turned to screw up the breech, so that the vent could only be open when the breech was tight. With the plain screw this was not so urgently required, and although the guard over the vent was retained for a time, it was not used. The vent hole was drilled in the gun barrel after the powder chamber was bored and the breech fitted and was ¾ inch diameter. About an inch at the top was tapped with ½ inch gas thread, and a copper plug fitted as tightly as possible for the whole length being screwed at the end to fit the hole. This copper plug had a small hole drilled through it to fit the friction tubes used.

A relieving hole ½ inch diameter was also drilled through the underside of the barrel from just behind the obturator, to prevent any damage to the thread from the product

of explosion, should the obturator ever act imperfectly. But at no time during firing was any smoke noticed coming from it. A flat place true with the axis of gun was planed on the top for standing a clinometer upon. A gun-metal casting bolted to the underside was cup-shaped to fit the end of elevating screw, which was turned to a ball. This it was found necessary to replace by a hinge joint, as the gun jumped on firing, and the elevating screw when in an inclined position tended to fall over, and the cup did not come fairly on to the ball end. The back sight, copied from that of one of the 2.5 inch R.A. guns, was provided with a fine traverse for wind allowance, &c., and was set at an angle of two degrees from the vertical (to the right) to allow for "drift" of shell, which was found on firing to be almost exactly correct. The front sight on the trunnion was first made as a bead in a small tube, but was afterwards altered to a knife edge without the tube. This completed the gun itself, ready for mounting on its carriage, as first turned out of the workshops.

Carriage – The carriage having been made in the meantime was ready for the gun. Its general construction is well shown in the accompanying photograph, Plate 39. It was formed of four steel plates ¼ inch thick, cut to shape, riveted together in pairs, 2 ½ inches apart, with distance sleeves on the rivets, and with gun-metal castings also acting as distance pieces and riveted in, for trunnion and axle bearings. The two pairs of plates were bolted together with shouldered bolts, 17 ½ inches apart, and with a rubbing plate at the trail end, which was also provided with an eye bolt for hanging to limber. The elevating screw was of steel, 2 ¼ inches diameter, with square thread ¼ inch pitch, working in a nut pivoted between the side frames, and provided with a hand-wheel. The axle was 4 ½ inches diameter keyed into the side frames.

The wheels were the only part not actually made, and they were a pair belonging to a portable engine and suited the purpose admirably. They were bored out, had gunmetal bushes driven in bored to fit the axles, and brass dust-caps screwed on outside. The height of the centre of the trunnions from the ground is 5 feet. The centre of trunnions is 5 inches behind, and the point of contact of the trail with the ground 9 feet 6 inches behind, the vertical line through the axle, and the wheels are 5 feet centre to centre.

With twenty-four days of continuous work the gun was ready, and on the 19th January 1900 it was taken out for testing and ranging, a firing platform and redoubt having been built at No. 2 Washing Machine, Kimberley Mine Floors, whence the Boer headquarters (the Intermediate Pumping Station of the Kimberley Waterworks Co.) and several of their gun positions could be commanded. The ranging was done with the assistance of the Company's surveyors, one having a theodolite at the point of firing, while another, also with a theodolite, was stationed at a point about a mile distant, nearly at right angles to the line of fire. On firing each took observations of the spot the shell struck, and the angle of firing as shown by clinometer, time of flight, charge of powder, &c., also being observed and tabulated, the muzzle velocity

was calculated, and range tables made for subsequent use, by Mr. C.D. Lucas. The back sight was not graduated for range, only being used for laying the gun, the firing party preferring to use the clinometer. The enemy appeared much disturbed when the first shells burst in their headquarters, and could be seen hurrying out in all directions, not expecting that they could be reached there, and there was no reply from any gun of theirs during the ranging trial. Mr. Rhodes was present the whole time and personally fired most of the shots, being very pleased with the performance of the gun, and the artillerists working it also were well satisfied with its shooting qualities. The trials having been completed, the gun was returned to the workshops for one or two minor alterations, including a new front sight and altered attachment for elevating screw, as already mentioned. These having been completed, the gun was handed over to the firing party and was in action on the 23rd January.

While in action 255 shells were fired in all by it, most of them being at ranges of 5,000 and 6,000 yards, these being reached with elevations of 12° and 15° respectively, with a powder charge of 5 lbs., the shell being 29 lbs. in weight. With the same charge a range of 8,010 yards was reached with an elevation of 24° 15′.

Ammunition. – It will be convenient here, before mentioning some further and serious difficulties experienced while the gun was in action, to describe the ammunition. The powder used has already been described. A good wool serge was chosen for the bags to form the cartridges, and they were made by a local draper, being hooped with silk ribbon. The "Ring" shell is shown in Fig. 11, Plate 42. The "Common" shell was similar, the only difference being in the absence of the rings cast in. Both kinds were used, their weight when filled with the bursting charge of 1 lb. powder being exactly 29 lbs. In making the shell the rings were first cast separately, then were mounted on a clay core, alternating tooth and space as will be noticed, the shell bursting better when thus arranged. This clay core with rings was then used as an ordinary core in the mould, and the metal poured. At first it was tried to cast them with the base solid, the core at that end supported by a "star", but this was not successful, the base being spongy in nearly every casting. Other methods were tried, and that adopted was to core them right through the base, that being downwards, and to pour in at a point about one-third the height from the end. Sound castings resulted. The cored hole in the base was plugged with a brass plug screwed in tight, and before issuing for service every shell was tested by steam at a pressure of 125 lbs. per square inch to detect blowholes, but none failed at that test, and no "prematures" were complained of. The shells after casting were turned to gauge, the point screwed for the fuse, and grooved for the copper gas-check, that being made from a ring turned and cut off to width required, then cut through with a saw, sprung into place and expanded into the dovetailed groove, afterwards being turned, and the relieving grooves cut. The insides of all shells were lacquered.

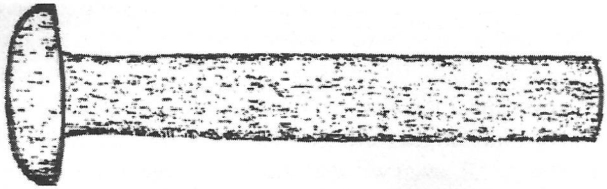
The percussion fuse was devised by Mr. Labram, his idea being to have the simplest possible one to make. The action of it is, that when the shell strikes and its forward motion checked suddenly, the plunger, which is filled with mealed powder, continues its motion forward, its impetus being sufficient to overcome the resistance of the safety spring and wires. The nipple strikes and explodes the cap, which is an ordinary percussion cap as used in sporting shot guns, the mealed powder is ignited and fires the charge in the shell.

It may be mentioned in passing that ammunition, both cartridges and shells – "common" and "ring" – had been made in the workshops and supplied to the garrison since early in November, for their 2.5 inch R.M.L. guns, the Government supply having been exhausted in about a month. This 2.5 inch shell is shown in Fig. 12, Plate 42.

From the time of its being handed over to the firing party on the 23rd January, the gun was fired steadily, the only trouble being a tendency for the end of the breech block to "upset" and get too tight in the screw. This was easily remedied by first easing the thread and subsequently removing one and then two threads at the end. On Saturday night firing ceased as usual, Sunday being observed as day of rest – from gun-firing – by die Boers. But at daybreak on Monday morning the first shot fired by "Long Cecil" was productive of an extra loud and peculiar report, and the idea that something had gone wrong was general. A telephonic message came from the redoubt immediately afterwards and an examination showed that the second ring in the outer row had burst through the line of the vent hole. The gun was at once sent down to the workshops for repair. To take off the first ring the foundary cupola was lighted, the gun hung from the crane with the breech in the sand, and a ring of metal run round the first ring which in two or three minutes expanded and dropped off, releasing also the broken one, to replace which a forging was already in hand. On removing the gun from the sand a further examination showed that the two rings of the first row immediately under the outer broken one were also broken, these having broken straight across on alternate sides of the gun, Fig. 2, Plate 40. To remove these necessitated a repetition of the process, one more outer ring - the third, and the first inner ring having to be expanded. New forgings were put in hand, and opportunity was taken then to make a careful examination of the tube, but no flaw or crack of any sort could be detected, nor any change of dimension beyond the slight barrelling of the powder chamber already mentioned, which does not seem to have increased with subsequent firing. The cause of the failure was not at all evident. Faulty welds were the first things looked for, but in vain; and although in the outer ring one part of the broken surface looked as if it might be an imperfect weld, in the two others there was no mark whatever, and no sign anywhere by which to trace the position of the weld. The outer ring had certainly broken through the vent hole, and from marks on the rings which appeared to be powder-smoke stains, the conclusion was come to that the

radial venting was the cause. The copper vent tube not being tight enough to withstand the great pressure, had allowed the gases to travel around it, and get under and between the rings, bursting them by direct pressure; and this action was assisted by a combination of favourable circumstances, namely, firing a 6 lb. charge of powder for the first shot in the morning, after the gun had been exposed to the cold air of the night, when the metal might be expected to be less tough than ordinarily. The outer ring was also weakened by having the vent hole through it, with the possibility of the weld happening to be at the same spot. The radial venting was condemned, and the breech prepared for an axial vent, experiment being first made to see whether the 'friction tubes' would strike through the distance necessary which it was found they would do easily. The vent hole in the gun tube was tightly plugged, and the new rings when ready shrunk on. No alteration was made in the breech block beyond boring the vent hole through the obturator bolt, and providing a safety device to prevent the friction tube blowing out behind and possibly injuring some person. These alterations, as shown in Fig. 4, Plate 40, having been completed, the gun was taken out to the redoubt again and put in action, but at the first shot under the new conditions, the obturator bolt (the same one as had been used all the time, and with which about 100 rounds had been fired) broke as shown in Fig. 4. A spare breech block had already been prepared with the obturator bolt increased in size to 2 inches diameter without shouldering, and the end brought right through the back plate, but at the first shot this one also broke off short under the mushroom head, and it was beginning to be an anxious time to know what to do to make something which would stand the shock, when one of the fitters let out that he had known a time at Woolwich when six or seven similar bolts had broken with successive shots – which statement somewhat relieved the anxiety – and he further suggested annealing in oil as an expedient which might help. This was immediately done, several bolts being made for emergencies, but none broke after that. The obturator bolts were made from ordinary rolled shafting 4 ½ inches diameter. One obturator bolt was made from cast steel 2 ½ inches square, the end being "jumped up" until of sufficient size to turn to the diameter required, but not tooled at all by the smith. This bolt was annealed as the others in melted tallow before finishing, but was not used. The present breech block is shown by Fig. 5, which also shows the peculiar drawing-down action taking place in these bolts. Three of them were used with two breech blocks from that time until the 15th February, when Kimberley was relieved, about fifty rounds being fired by each bolt. The only way to account for the action seems to the author to be that the shock of the explosion drives the whole bolt back, compressing the asbestos pad. Then on the relief from the pressure, the pad expands again, tending to bring the bolt back to its original position, which is opposed by the inertia of the body of the bolt, causing a tensile stress in the bolt which is sufficient to cause permanent set at the point where the greatest stress comes, close to the head. A photograph of one of the bolts is shown in Fig. 13.

FIG. 13-Obturator Bolt.
made from ordinary rolled shafting 4 1/2 inches diameter



Kimberley was relieved before any further difficulties arose, and the gun is now resting, waiting for its next position, which it is expected will be in a prominent position in the town, forming part of a monument to the memory of these who fell in the defence of Kimberley, and chiefly of him who originated it – George Labram – who, by his great mechanical skill and general resourcefulness in all matters, contributed in no small degree to that end, and who was most regrettably killed only a few days before relief came.

The Paper is accompanied by a number of blue prints and photographs, from which the four Plates, Nos. 39-42, have been prepared.

Discussion

The Chairman said Mr. Goffe was not present. The Paper recounted a piece of very remarkable work done under most remarkable circumstances, but it was not intended to have a long discussion upon it owing to Mr. Goffe's absence. Mr. H.F. Donaldson, of Woolwich, who was present, would perhaps make a few remarks.

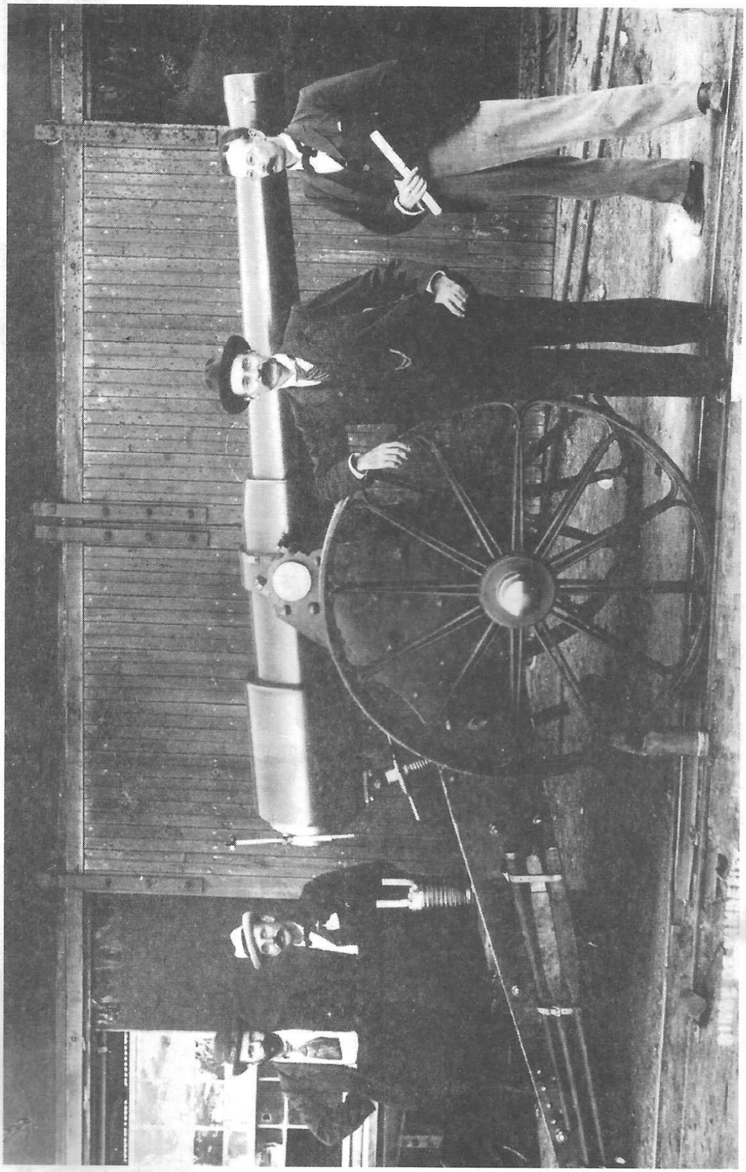
Mr. H.F. Donaldson said he had not come prepared to make any remarks at all. At the same time it was a great plessure to him to bear witness to the skill, the initiative, and to the success which met the efforts of Mr. Labram. Mechanical engineers worked best in peace, but when circumstances called upon them requiring special effort, it was a matter of congratulation that someone was generally there to take hold of whatever there was possible of manipulation, and turn out excellent results. He thought it was really wonderful, because so far as he was aware Mr. Labram had had no experience in gun-making, and he carried out the whole of his calculations and the whole of his work based upon the recollection of a lecture which presumably he had heard from the late Sir William Anderson, and by the assistance of illustrations in an engineering paper. Therefore the credit due to Mr. Labram and those who assisted him was so much the greater. There were just two points with regard to the troubles

that arose on which perhaps he might be permitted to say a word or two. One was with reference to the fracture of the rings. It seemed very probable that the reason suggested for that fracture was correct, but another possible cause may have been unequal contraction and consequently unequal initial strains on the metal of the rings. With regard to the fracture of the stalk of the bolt, the oil annealing undoubtedly assisted in getting over the difficulty, but it struck him that had the sharp angle which was shown in Fig. 4, Plate 40, been largely curved, it was quite possible there would have been no fracture at all, even without the oil annealing. Still at the same time oil annealing was a common process for such work. He wished to express his appreciation of the clear way in which the description of the carrying out of the work was given in the Paper.

The Chairman thought the members would agree with him that Mr. Goffe deserved a hearty vote of thanks for his most interesting Paper; and on formally putting the motion it was carried unanimously.

Fig. 1 CONSTRUCTION OF "LONG CECIL" GUN

4.1 inch B.L. Siege Gun "Long Cecil" made at the workshops of the De Beers Consolidated Mines during the Siege of Kimberley, 1899-1900.

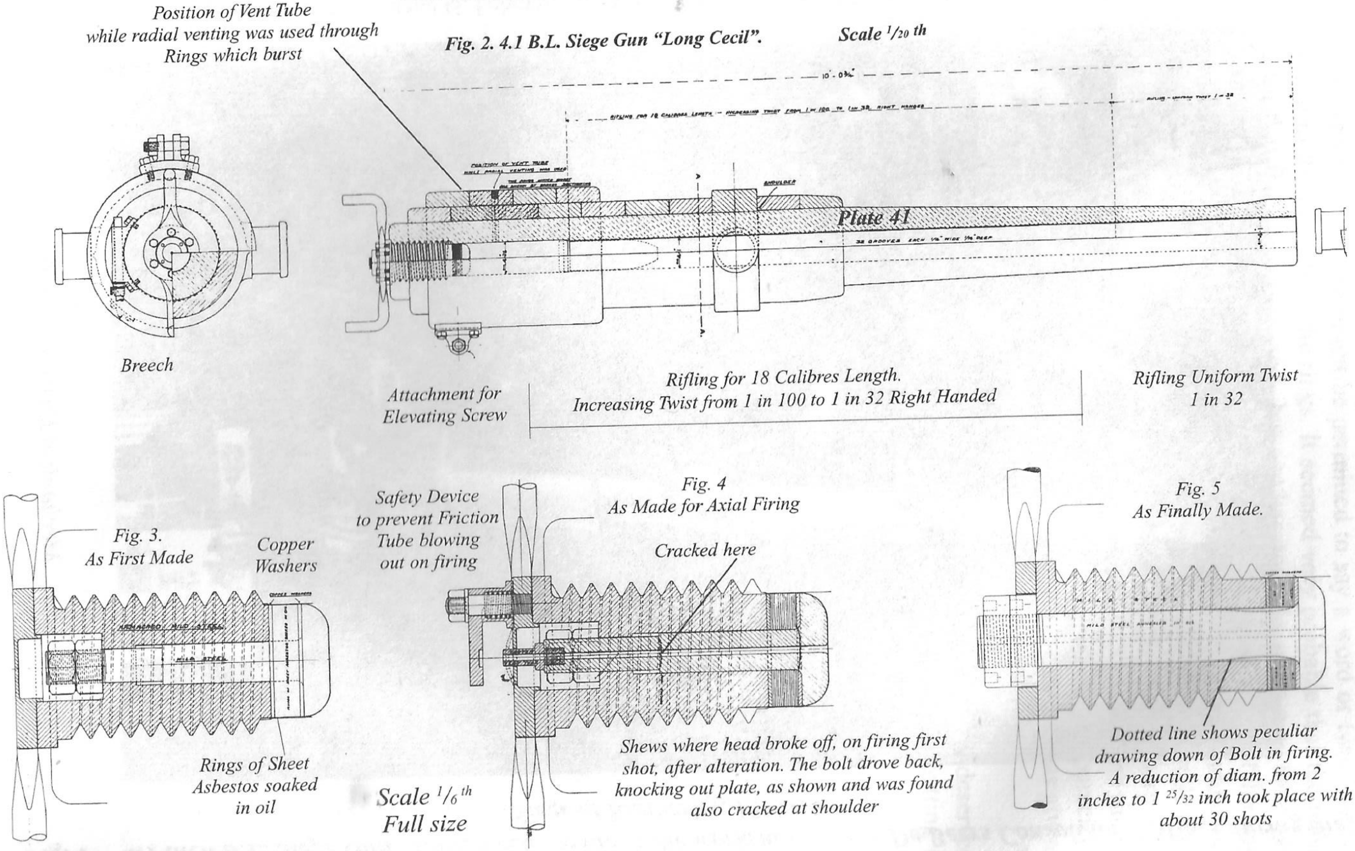


On the right of Long Cecil stand G. Labram, Late Chief Engineer D.B.C.M., killed 9th Feb., 1900 and E. Goffe, Chief Draughtsman, D.B.C.M.

Mechanical Engineers 1900

Plate 40

CONSTRUCTION OF "LONG CECIL" GUN



Mechanical Engineers 1900

CONSTRUCTION OF "LONG CECIL" GUN

Plate 41

Fig. 6 Rifling Device

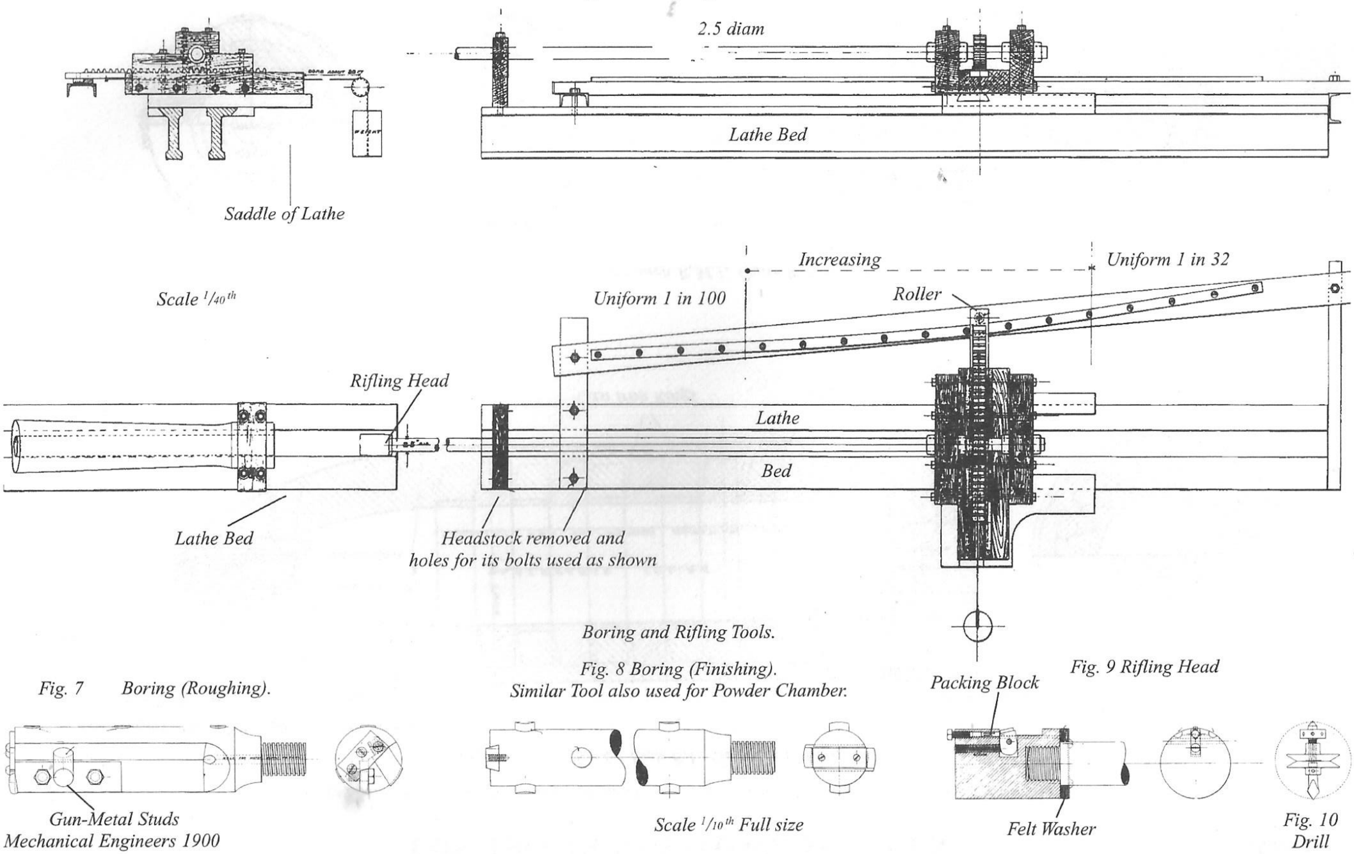


Plate 42

CONSTRUCTION OF "LONG CECIL" GUN

Ring Shells made at the workshops of the D.B.C. Mines during the Siege of Kimberley, 1899-1900

Fig. 11 **For 4.1 inch B.L. Siege Gun "Long Cecil"**

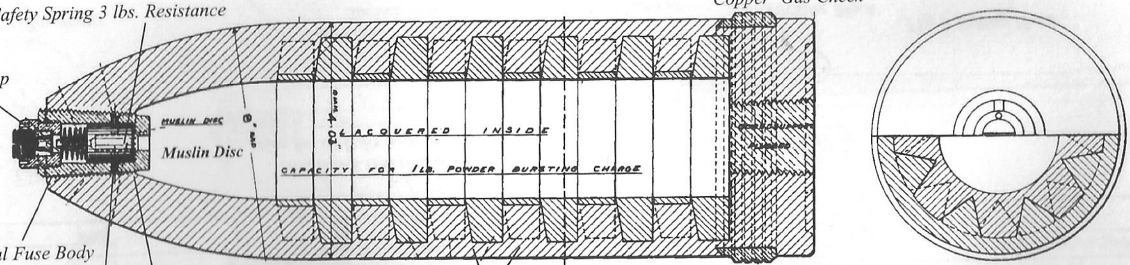
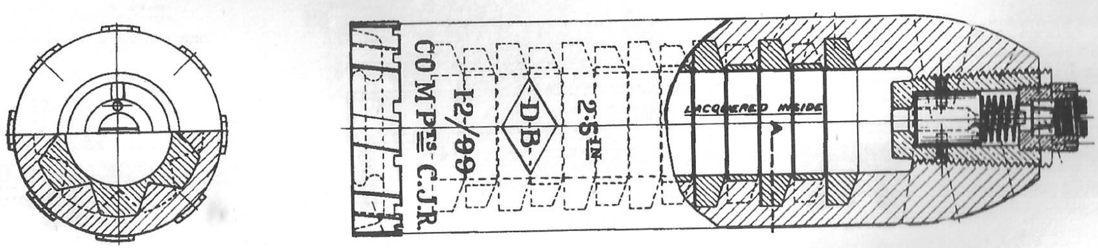


Fig. 12 **For 2.5 inch R.M.L. Guns R.A. & D.F.A.**



Scale 1/3 full size

Mechanical Engineers 1900